REMARKS/ARGUMENTS

Reconsideration of this application in light of the above amendments and following comments is courteously solicited.

The invention as claimed in claim 1 is directed to a copper alloy consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities, which has a hardness Hv of 80.2 to 103.1, wherein a proportion of an alpha phase is 90 vol% or more, and wherein an apparent content B′ of zinc in said copper alloy is in the range of from 34 to 39 wt%, said apparent content B′ of zinc being expressed by the following expression:

$$B' = [(B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4) / (A + B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4)] \times 100$$

wherein A denotes the content (wt%) of copper and B denotes the content (wt%) of zinc, t_1, t_2, t_3 and t_4 denoting zinc equivalents of tin, silicon, nickel and iron, respectively ($t_1 = 2.0$, $t_2 = 10.0$, $t_3 = -1.3$, $t_4 = 0.9$), and q_1, q_2, q_3 and q_4 denoting the contents (wt%) of tin, silicon, nickel and iron, respectively.

The invention as claimed in claim 12 is directed to a copper alloy consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities, which has a hardness Hv of 80.2 to 103.1, wherein an apparent

content B' of zinc in said copper alloy is in the range of from 34 to 39 wt%, said apparent content B' of zinc being expressed by the following expression:

$B' = [(B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4) / (A + B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4)] \times 100$

wherein A denotes the content (wt%) of copper and B denotes the content (wt%) of zinc, t_1, t_2, t_3 and t_4 denoting zinc equivalents of tin, silicon, nickel and iron, respectively ($t_1 = 2.0$, $t_2 = 10.0$, $t_3 = -1.3$, $t_4 = 0.9$), and q_1, q_2, q_3 and q_4 denoting the contents (wt%) of tin, silicon, nickel and iron, respectively.

Such copper alloys have an excellent stress corrosion cracking resistance and an excellent dezincing resistance while maintaining excellent characteristics of conventional brasses.

Such copper alloys can be produced by the following method.

First, there are prepared raw materials of a copper alloy consisting essentially of 58 to 62.8 wt% of copper, 0.3 to 0.5 wt% of tin, 0.03 to 0.5 wt% of silicon, at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth, at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in the range of from 0.02 to 3.0 wt%, and the balance being zinc and unavoidable impurities.

Then, the above-described raw materials are mixed so that an apparent content B' of Zn is in the range of from 34 to 39 wt%, the apparent content B' being equal $[(B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4) / (A + B + t_1q_1 + t_2q_2 + t_3q_3 + t_4q_4)] \times 100$, wherein A denotes the content (wt%) of Cu and B denotes the content (wt% of Zn, t_1, t_2, t_3, and t_4 denoting zinc equivalents of Sn, Si, Ni and Fe, respectively ($t_1 = 2.0$, $t_2 = 10.0$, $t_3 = -1.3$, $t_4 = 0.9$), and q_1, q_2, q_3 and q_4 denoting the contents (wt%) of Sn, Si, Ni and Fe, respectively.

Then, after the mixture is cast to form an ingot, it is

extruded in a temperature range of from 600 to 850°C. By the mixing, it is possible to obtain an alpha-plus-beta phase structure having a good hot workability in a high temperature region. After the hot forging or cold reduction of a bar thus obtained is carried out, the bar is heat-treated at a temperature of 300 to 600°C for two minutes to five hours, and then cooled at a cooling rate of 0.2 to 10°C/sec to control the structure.

By carrying out the heat treatment, the beta phase portion after extruding is changed to an alpha or gamma phase except for a part of the beta phase portion. At this time, the concentration of additives in the residual beta phase increases, and the solid solution of Si is formed in the alpha phase, so that the stress corrosion cracking resistance and dezincing resistance of the bar are improved. If the heat treatment temperature is lower than 300°C, phase transformation is not sufficiently carried out. If the heat treatment temperature is higher than 600°C, the beta phase is stable, so that no alpha-plus-gamma phase is deposited. Therefore, the heat treatment temperature is preferably in the range of from 300 to 600°C. If the cooling rate is higher than 10°C /sec, there is the possibility that distortion may be caused by cooling. If the cooling rate is lower than 0.2 °C/sec, there are some cases where the size of crystal grains increases to have an influence on dezincing resistance. Therefore, the cooling temperature is preferably in the range of from 0.2 to 10°C/sec.

Furthermore, newly added claims 14 and 16 are supported on page 11, line 35 through page 12, line 9 of the specification of the instant application, and newly added claims 15 and 17 are supported on page 12, lines 10-25 of the specification of the instant application.

Claims 1 and 11-13 were rejected under 35 U.S.C. §103 as

being unpatentable over U.S. 2002/0015657 to Dong.

Dong discloses a copper-base alloy comprising 57 to 60 wt% of copper, 0.3 to 3 wt% of tin, 0.02 to 1.5 wt% of silicon, 0.5 to 3 wt% of lead, and any one of 0.02 to 0.2 wt% of phosphorus, 0.01 to 2 wt% of iron and 0.01 to 2 wt% of nickel. Therefore, the composition disclosed by Dong in [0017]-[0019] overlaps claimed alloy composition.

Dong also discloses a sample of a copper-base alloy having a hardness Hv of 102 (Sample No. 13), and a sample of a copper-base alloy having a hardness Hv of 98 (Sample No. 17). Therefore, the hardness of the samples (Sample Nos. 13 and 17) disclosed by Dong overlaps claimed alloy hardness.

However, the composition of the samples (Sample Nos. 13 and 17) disclosed by Dong does not overlap claimed alloy composition. Therefore, Dong fails to disclose or suggest any copper alloys having both of alloy composition and hardness as claimed in claims 1 and 12. That is, Dong fails to disclose or suggest any copper alloys having claimed alloy composition as well as claimed hardness.

Dong discloses a method for producing the above-described copper-base alloy by casting the raw materials of the alloy to form a billet, holding the billet at 800°C for 30 minutes, and then, hot extruding the billet into a bar.

Dong also discloses that the γ phase is dispersed uniformly between regions of α phase to improve resistance to dezincification while assuring hot deformability and that a heat treatment must be performed after hot working in order to elicit the effect of improving resistance to dezincification.

However, Dong fails to disclose or suggest any copper alloys wherein a proportion of an alpha phase is 90 vol% or more. That is, the method of Dong does not include any steps of

annealing the cold or hot worked ingot at a temperature of 300 to 600°C for two minutes or five hours and cooling the annealed ingot at a cooling rate of 0.2 to 10°C/sec. Therefore, the method of Dong cannot produce any copper alloys wherein a proportion of an alpha phase is 90 vol% or more. In fact, all of the copper-base alloys of Dong have an alpha phase proportion of less than 90 vol%.

Thus, Dong fails to disclose or suggest any copper alloys having all of alloy composition, hardness and alpha phase proportion as claimed in claim 1. That is, Dong fails to disclose or suggest any copper alloys having both of claimed alloy composition and hardness as well as claimed alpha phase proportion.

Therefore, Dong fails to disclose or suggest any copper alloys having an excellent stress corrosion cracking resistance and an excellent dezincing resistance while maintaining excellent characteristics of conventional brasses.

Therefore, it would not have been obvious to one having ordinary skill in the art at the time the invention was made to make the present invention on the basis of the teaching of Dong.

Claims 1 and 11-13 were rejected under 35 U.S.C. §103 as being unpatentable over U.S. 4,259,124 to Smith et al. in view of U.S. 2002/0015657 to Dong.

Smith discloses an alloy consisting essentially of 0.1 to 2.0% by weight tin, 0.1 to 2.0% by weight silicon, 20 to 34% by weight zinc, and the balance copper.

However, Smith fails to disclose or suggest any copper alloys containing at least one of 0.3 to 3.5 wt% of lead and 0.3 to 3.0 wt% of bismuth. Smith also fails to disclose or suggest any copper alloy containing at least one of 0.02 to 0.15 wt% of phosphorus, 0.02 to 3.0 wt% of nickel and 0.02 to 0.6 wt% of iron, the total amount of phosphorus, nickel and iron being in

the range of from 0.02 to 3.0 wt%. Therefore, the composition disclosed by Smith does not overlap claimed alloy composition.

In addition, Smith fails to disclose or suggest any copper alloys having the claimed hardness, i.e., a hardness Hv of 80.2 to 103.1.

Moreover, Smith fails to disclose or suggest any copper alloys wherein a proportion of an alpha phase is 90 vol% or more.

Thus, Smith fails to disclose or suggest any copper alloys having all of claimed alloy composition, hardness and alpha phase proportion. Therefore, Smith fails to disclose or suggest any copper alloys having an excellent stress corrosion cracking resistance and an excellent dezincing resistance while maintaining excellent characteristics of conventional brasses.

Thus, Dong and Smith fail to disclose or suggest any copper alloys having both of alloy composition and hardness as claimed in claims 1 and 12. Dong and Smith also fail to disclose or suggest any copper alloys having all of alloy composition, hardness and alpha phase proportion as claimed in claim 1.

Therefore, it would not have been obvious to one having ordinary skill in the art at the time the invention was made to make the present invention on the basis of the teaching of Smith in view of Dong.

Accordingly, it is believed that the claims patentably distinguish the invention from the prior art.

An earnest and thorough attempt has been made by the undersigned to resolve the outstanding issues in this case and place same in condition for allowance. If the Examiner has any questions or feels that a telephone or personal interview would be helpful in resolving any outstanding issues which remain in this application after consideration of this amendment, the Examiner is courteously invited to telephone the undersigned and

the same would be gratefully appreciated.

It is submitted that the claims as amended herein patentably define over the art relied on by the Examiner and early allowance of same is courteously solicited.

If any fees are required in connection with this case, it is respectfully requested that they be charged to Deposit Account No. 02-0184.

Respectfully submitted,

By /Gregory P. LaPointe #28395/
Gregory P. LaPointe
Attorney for Applicants
Reg. No.: 28,395

Telephone: 203-777-6628
Telefax: 203-865-0297

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